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EVALUATION OF TACTILE PROMPTS WITH A STUDENT WHO IS DEAF, BLIND, AND MENTALLY RETARDED

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We provided tactile cues to a student who was deaf, blind, and mentally retarded to guide her performance on a variety of packaging tasks. The student had previously received extensive training on multiple packaging and sequencing tasks through her vocational education program. Although she was able to complete these tasks, each change in materials necessitated that similar levels of retraining be conducted in order for her to perform revised tasks. Tactile cues were introduced and evaluated through a multiple baseline with sequential withdrawal design for two envelope-stuffing tasks and one bagging task. Results indicated that the tactile prompts were effective in guiding her performance on the training task and in promoting generalization to novel tasks and cues. Continued use of the cues was necessary to maintain the student's performance. Our findings suggest that tactile prompts function similarly to picture prompts and may be an effective alternative external prompting system for persons for whom picture prompts would not be appropriate.

DESCRIPTORS: tactile prompts, generalization, severely handicapped

At least two approaches for promoting generalization across settings and task variations among persons with severe handicaps have been described in the literature. One approach emphasizes training students to respond to naturally occurring discriminative stimuli (i.e., stimuli contained within the task) to perform novel examples of the task. Training sufficient exemplars and general case instruction are two examples of this approach (Horner & McDonald, 1982; Sprague & Horner, 1984; Stokes & Baer, 1977). Although it is desirable to have students respond to naturally occurring stimuli, in some instances these stimuli may not be sufficient (i.e., may not function as discriminative stimuli) to guide the individual's performance. In other instances, the stimuli may prove to be sufficient, but it may be more efficient to modify the environment rather than to train the student to perform under the control of the naturally occurring stimuli. In these instances, a second approach, training students to use an external prompting system, may be desirable.

External prompting systems involve the provision of extra stimuli (stimuli that are added to the task or setting) that students learn to use to guide their behavior across task variations (Gifford, Rusch, Martin, & White, 1984; Martin, Rusch, James, Decker, & Trtol, 1982; Wacker & Berg, 1983; Wacker, Berg, Berrie, & Swatta, 1985). The most common example of an external prompting system is picture prompts, which serve to control behavior by depicting each step in a chain of responses. The pictures, usually bound together in a book, are controlled (regulated) by the student, who is trained to perform the step depicted, turn the page, and perform the next step depicted. Once the student learns to use the pictures, the probability of generalization may be increased; that is, the student may be able to perform novel tasks using novel pictures by following the same sequence of behaviors (look, do, turn page, look, etc.) originally trained.

Perhaps the major advantage of an external prompting system is that the potential range of stimuli guiding behavior is reduced (Gifford et al., 1984), thus reducing the need to transfer stimulus control from the cues provided during training to

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the cues occurring within the natural environment (Cuvo & Davis, 1983). For example, when picture prompts are used, the individual is taught to respond to the antecedent stimuli provided by the pictures. During generalization conditions, either the same stimuli (same pictures across settings) or similar stimuli (pictures depicting other task steps) are used to guide performance. Thus, the probability for generalization of performance may be increased because the discriminative stimuli are common across the two conditions (Stokes & Baer, 1977).

Although research into the use of picture prompts has generally yielded positive results, the applicability of such prompts to many individuals with disabilities (e.g., blind or deaf and blind) is limited. Therefore, other external prompting systems are needed. If picture cues function by limiting and stabilizing the range of stimuli that the individual uses to guide his or her performance (Martin et al., 1982), then other systems that also provide a stable set of discriminative stimuli may also guide behavior.

The present investigation was conducted to extend previous findings on the use of permanent prompt systems with individuals with severe handicaps. In this investigation, tactile prompts were evaluated for their effectiveness as an external prompting system for a student who was mentally retarded, deaf, and blind. The tactile cues were evaluated to determine (a) their effects on guiding performance on a vocational task (packaging), (b) their effects on generalization to variations of this task (new materials and setting), and (c) the need for their continued use following training.

METHOD

Subject

Tammy was 19 years old and functioned within the moderate to severe range of mental retardation. Tammy was also legally deaf and blind. She had a severe hearing loss in both ears, and although she wore a hearing aid, audiologists' reports indicated that she was unable to distinguish between background and relevant sounds. Tammy had no vision (she wore artificial eyes). She used a walking stick and demonstrated independent mobility skills in familiar environments. Tammy responded to modified manual signs performed in her hands and used a few modified signs to communicate with others. Verbal statements always accompanied the manual signs provided to Tammy as part of a total communication program.

As part of her education program, Tammy had received instruction on simple sequencing and packaging tasks. Although Tammy successfully mastered specific tasks after extensive training, generalization of these skills did not occur. When novel materials were used (either fillers or containers), her performance always decreased to pretraining levels, necessitating the provision of extensive training time to increase her performance to acceptable levels. Her classroom teacher reported that Tammy's failure to generalize her performance to any change in materials was a major problem for her vocational training.

Tasks

Three packaging tasks were used for the investigation: two envelope-stuffing tasks (Tasks A and B) and one bagging task (Task C). Task A was the training task, and Tasks B and C served as generalization tasks. For both envelope-stuffing tasks, three items were to be placed into either a legal-size envelope (Task A) or a large manila envelope (Task B). The bagging task required that three items be placed into a plastic bag.

For each task, the required materials were placed in separate compartments of a wooden acquisition tray (76 by 39 cm). The tray was divided into two rows of six compartments. In the second row, six to eight examples of each item used for packaging or six to eight examples of a distractor item were placed in five compartments. The sixth compartment remained empty. The sequence of the items within the second row was random and was changed at the beginning of each session.

Five compartments in the first row of the tray contained one (5 by 5 cm) tactile cue, and the sixth compartment remained empty. The tactile cues were either numbers (training set) or letters (generali-

zation set) drawn with glue and covered with sand. The cues were placed in either numerical or alphabetical order from left to right across compartments. Identical cues were attached with Velcro® one to a page (11 by 9 cm) and bound into a book. The cues in the book were rearranged at the beginning of each session to correspond with the new arrangement of the materials to be packaged. In this way, Tammy needed to respond to the tactile cues rather than to a fixed order of the materials. It was considered critical that Tammy learn to use the cues to guide her performance, because her previous history of learning fixed sequences of materials had not resulted in generalization.

Design

The investigation was conducted within a multiple baseline (across tasks) with sequential withdrawal design. Six conditions were used for the training task: baseline, training, Posttraining 1 and 2, generalization probes, and maintenance probes. The purpose of these conditions was to determine whether (a) the tactile cues, when separated from other components of training, guided performance (Posttraining 1 and 2), (b) the use of tactile cues promoted generalization of performance to new materials and settings (generalization probes), and (c) the use of tactile cues facilitated maintenance of performance over time (maintenance probes).

Reliability

Point-by-point reliability was computed for either the task steps (baseline and Posttraining 2) or for both the task steps and the book steps (training, Posttraining 1, generalization and maintenance probes) for 25 sessions (17% of sessions). A minimum of four reliability probes was conducted for each task. During the reliability probes, an author and one additional observer independently scored Tammy's performance. An agreement was scored when both observers recorded that the same task step or book step was performed either correctly or incorrectly; a disagreement occurred when a step was not scored the same by both observers. Reliability was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Mean reliability was 99% and ranged from 95% to 100%.

Procedure

Baseline. Baseline sessions for the training task and two generalization tasks were 15 min long and began with a demonstration of a correctly completed sample of the task. At the beginning of each session, Tammy's right hand was placed in each compartment of the acquisition tray, and one sample of the item in each compartment was placed in her hand. Tammy then received a correctly completed sample of the task (envelope or bag) she was to perform, and her hands were guided through the sample. Following the demonstration, instructions to "make the same" were signed into her hands and spoken. No correction or reinforcement was provided by the examiner during the baseline condition.

The baseline condition was extended across the three tasks to form a multiple baseline design. The final two baseline sessions for the bagging task were conducted immediately following the completion of posttraining on the generalization set of cues.

Training. The first phase of training was conducted for the training task only and consisted of seven steps to teach Tammy to match-to-sample using the tactile cues. For Training Step 1, Tammy was required to touch a tactile cue attached to a page, find the matching tactile cue from two alternatives in front of her, and pick up the item directly behind the cue. Additional book cues and alternatives were added one at time (necessitating that she also turn the page) until Tammy was able to match four book cues correctly among five alternatives (Training Step 7). The criterion for progressing from one training step to the next was errorless performance for two consecutive trials, which included a change in the sequencing of the book cues. Contingent correction and praise were provided throughout Training Steps 1 through 7. Correction consisted of signing "No" into Tammy's hand, and then placing Tammy's hand on the cue in the tactile book and signing "Want same." If Tammy erred immediately following this correction, she was physically guided through the correct

sequence of steps. Praise consisted of a gentle pat or rub on the shoulder. This procedure was used as reinforcement because it was similar to the procedure followed by her foster mother and teacher.

The second phase of training, Step 8, used the same samples and alternative cues as Training Step 7 and required Tammy to use the tactile cues to perform the entire envelope-stuffing task. Two types of information were collected: task steps completed correctly and book steps completed correctly. Task steps were the same steps scored in baseline. Book steps included turning the page, touching the cue on the page, and starting at the left of the acquisition tray.

During Training Step 8, Tammy was required to touch the cue on the first page, to find the matching cue on the tray, to pick up one of the items located directly behind the cue, to perform the task step, and to turn the page. Training Step 8 was continued until Tammy performed with at least 90% accuracy for both task and book steps. The same correction procedure used for Training Steps 1 through 7 was used for Training Step 8. The reinforcement procedure used for Training Steps 1 through 7 was accompanied by self-delivered reinforcement for correct responses. The praise delivered by the trainer was decreased as training progressed to discourage Tammy from relying on trainer feedback for information regarding the accuracy of her performance.

The self-delivered reinforcement routine was established to augment trainer-delivered praise. Self-delivered reinforcement consisted of Tammy's selecting an edible reinforcer following correct responding. Edibles were used because of Tammy's history of receiving food following correct responding. During the initial training sessions for Step 8, one piece of food (cereal, popcorn, or part of a cookie) was placed on a plate to the left of the acquisition tray. Tammy was taught to take the food item each time she correctly packaged an item. After several sessions, 10 pieces of food were set out at the beginning of the session and remained available throughout the session. Tammy was allowed to take one piece of food after she correctly packaged an item. During the final training sessions, the examiner provided feedback regarding accuracy of performance for both task steps and book steps, but did not provide instruction on self-delivered reinforcement. Tammy consistently selected one food item only after correctly packaging an item. For Posttraining 1 and 2 and generalization and maintenance probe sessions, the edible reinforcers were available throughout the entire session, and no feedback was provided regarding the accuracy of self-delivered reinforcement.

Training Step 8 also was conducted following the generalization probes during all generalization conditions (tasks, tactile cues, and maintenance) if Tammy performed at less than 90% accuracy. Training Step 8 was continued until Tammy performed with 90% accuracy or better on both the task steps and the book steps.

Posttraining 1 and 2. For all three tasks and the generalization set of tactile cues, Posttraining 1 was conducted following Training Step 8. Posttraining 1 was the same as Training Step 8, except that no contingent correction or praise was provided by the investigators. The self-delivered reinforcement routine established during Training Step 8 was continued, but no feedback was provided to Tammy regarding when she had earned a reinforcer.

Posttraining 2 followed Posttraining 1 and was conducted under the same conditions as Posttraining 1, except that the tactile cue book was removed. If Tammy performed with less than 90% accuracy during Posttraining 2, the tactile cue book was returned and Posttraining 1 conditions were reimplemented.

Generalization probes. Generalization probes were conducted under the same conditions as Posttraining 1 for the two generalization tasks and the generalization set of cues. The tactile cue book was available, but no contingent reinforcement or correction was provided by the investigators. Again, the routine established for self-delivered reinforcement was continued.

Maintenance probes. Maintenance probes were conducted following a 3-week break after the completion of the investigation. Tammy did not have access to the tactile cues or task materials throughout this period. Maintenance probes were con-

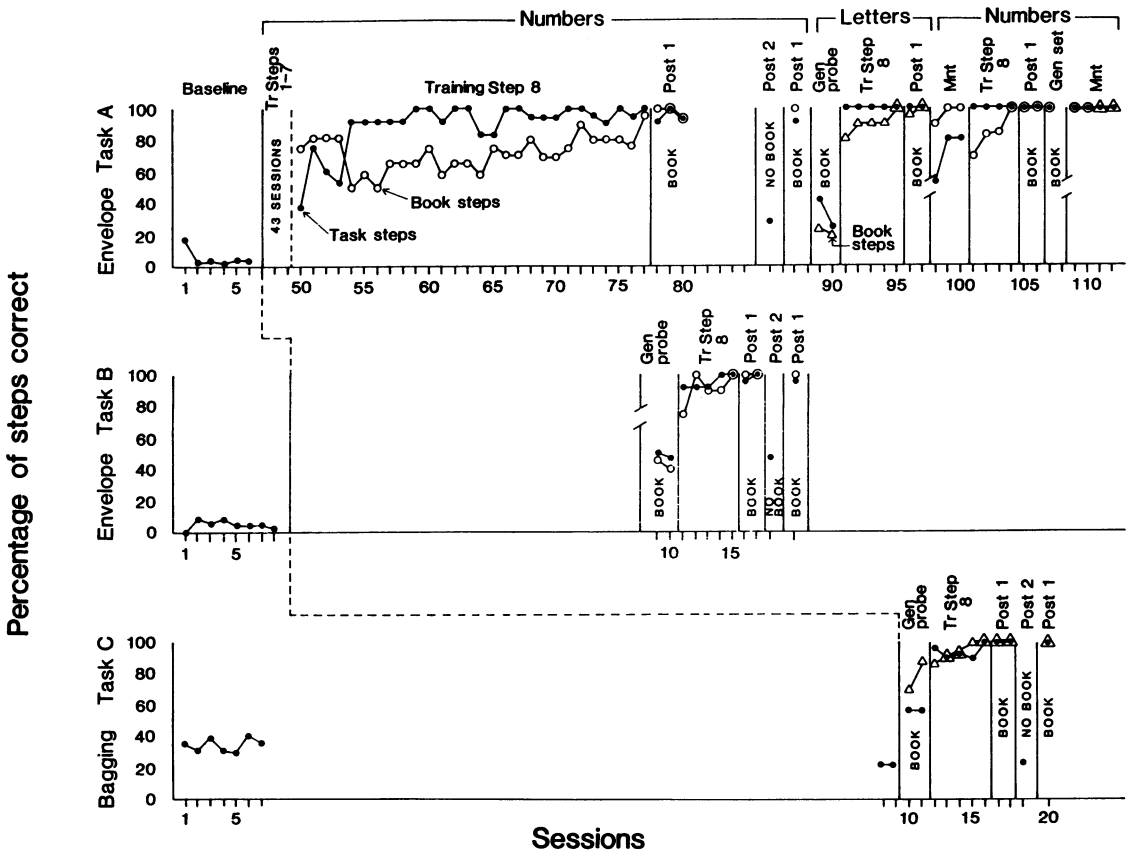

Figure 1. Percentage of task steps and book steps correctly completed by Tammy.

ducted under the same conditions as Posttraining 1 and occurred only for the original training task. Training Step 8 and Posttraining 1 were conducted if Tammy performed with less than 90% accuracy. Additional maintenance probes were conducted 1 week later. The second set of maintenance probes was conducted on Task A using both the training set of tactile cues (numbers) and the generalization set of tactile cues (letters).

Generalization across settings. One probe was conducted to assess generalization of performance across settings on the original training task. This probe was conducted under the same conditions as Posttraining 1 but occurred in an office setting.

RESULTS AND DISCUSSION

As indicated in Figure 1, Tammy's performance on the three tasks never exceeded 41% accuracy during baseline. Tammy acquired the matching-to-sample skills (Training Steps 1 through 7) within 43 sessions and was trained to use the cue book and complete the first envelope-stuffing task (Task A) within 28 sessions. During Posttraining 1, she performed both the book steps and task steps at 92% accuracy or better for Task A.

During the two generalization probes for Task B (the cue book was available), her performance on the task steps improved from baseline levels of less than 10% accuracy to 50% and 46% accuracy. With the implementation of Training Step 8, Tammy's performance increased to 100% accuracy for both the book steps and the task steps within five sessions. She performed at 95% accuracy or better during the Posttraining 1 condition.

When the cue book was removed (Posttraining 2) for both envelope-stuffing tasks, Tammy's performance decreased to 28% accuracy for Task A

and to 46% accuracy for Task B. Once the book was returned, her performance returned to Posttraining 1 levels.

When the generalization set of tactile cues (letters) was provided for Task A, Tammy performed at 42% and 23% accuracy on the task steps and at 25% and 20% accuracy on the book steps. With the implementation of Training Step 8, her performance increased to 100% accuracy for both the task and the book steps within five sessions. Her performance remained at 95% accuracy or better throughout the Posttraining 1 condition.

During the two generalization probes for the bagging task (Task C) using the generalization set (letters) of tactile cues, Tammy performed with 70% and 87% accuracy on the book steps and with 53% accuracy on the task steps. Her performance increased to 100% accuracy for both sets of steps within five sessions following training and remained at 100% accuracy throughout the Posttraining 1 condition. When the tactile cues were removed (Posttraining 2), Tammy's performance decreased to 23% accuracy, the same level of accuracy displayed for the final two baseline sessions. Her performance returned to 100% accuracy for both sets of steps once the tactile cue book was returned.

During the maintenance probes, Tammy's performance on the book steps remained at 90% accuracy or better; however, her performance on the task steps dropped to 53% accuracy for the first session but then increased to 80% accuracy for the remaining two sessions. Training Step 8 was conducted, and Tammy's performance returned to 100% accuracy for both sets of steps within four sessions. At this time, Tammy was taken to an office setting to perform the original training task. Tammy performed with 100% accuracy for both the book steps and task steps in the office setting under posttraining conditions.

Additional maintenance probes were conducted 1 week later. Tammy performed the original training task using both sets of tactile cues (two sessions were conducted with each set of cues). Her performance remained at 100% accuracy for both the book and the task steps and with both sets of tactile cues.

The results of this investigation indicate that tactile prompts function similarly to picture prompts in guiding behavior. Several similarities exist between the results of the current investigation and previous research conducted with picture prompts. First, although the initial training time has frequently been extensive, the students have required either no or substantially reduced training to use the prompting system to perform variations of the training task. Second, continued use of the prompting system was necessary for improved performance to occur.

In the current investigation, Tammy's posttraining performance was evaluated within two conditions: (a) the tactile cue book and self-delivered reinforcement routine were retained, but no staff feedback was provided, and (b) the self-delivered reinforcement routine was retained, but neither the tactile cue book nor staff feedback was provided. Tammy's ability to continue her high levels of performance in the absence of trainer feedback, but not in the absence of both trainer feedback and the cue book, indicate that (a) Tammy's performance was guided mainly by the cue book, rather than by trainer feedback or the self-delivered reinforcement routine, and (b) Tammy had not learned the target task, but rather, had learned to use a prompting system to guide her performance.

Wacker and Berg (1984) suggested that when the tasks are relatively unfamiliar and relatively brief training is provided, the removal of the external prompting system may disrupt performance. In other situations, even when extensive training is provided, the natural cues simply never function as discriminative stimuli. For example, in the Wacker and Berg (1983) and the Wacker et al. (1985) investigations, the picture cues may have served to augment (highlight) the naturally occurring cues for the students. Therefore, no disruption in performance occurred when the pictures were removed. In the study by Wacker and Berg (1984) and in the present investigation, the prompts may have replaced the naturally occurring cues because of the minimal training provided on the target tasks (Wacker & Berg, 1984) or because the natural cues did not function as discriminative stimuli, even with extensive training (present investigation).

The results of this investigation, although prom-

ising, should be interpreted with caution, because of several limitations of the study. Replication of these findings with other individuals and different tasks is needed to address any potential order effects of the tasks and cues used with Tammy and to extend the external validity of the results. The current investigation would have been strengthened by an evaluation of the necessity of Training Steps 1 through 7, an evaluation of the effect of Training Step 8 on Tammy's baseline performance for Task B, and an evaluation of the role of the self-delivered reinforcement routine on Tammy's posttraining performance. Also, although Tammy's history suggests that the naturally occurring cues did not function as discriminative stimuli, implementation of a fading procedure for the tactile cues may have resulted in different conclusions. Finally, a longer period between the end of training and the evaluation of maintenance of performance would have been desirable.

Future research might focus on whether or not students demonstrate preferences among alternative prompting systems. If students have preferences, this might be related functionally to maintenance of performance. Given that many students continue to need a prompting system to maintain acceptable performance (as demonstrated by reversal conditions), it is likely that students who prefer one system over another will also display greater maintenance of their use of that system.

Tammy is currently working for pay in a community job site through a supported work program. Her use of the tactile cues has been expanded to enable her to select the correct buttons on an elevator, use vending machines, and perform photocopying, collating, and envelope-stuffing tasks at her job. She also uses tactile prompts at home to operate various appliances. In every case, the tactile prompts have been made a permanent part of the task. In addition, the self-delivered reinforcement routine established during Training Step 8 has been continued at the job site using money rather than edible reinforcers.

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